CHAPTER IV

EXAMPLES AND CONCLUSION

The computer source program developed by Yuthana (8) has been modified to include the extension of line supports. Program manual, example of input data and output results are shown in Appendix F. The computation performs on free edge rectilinear flat plates supported by combination or alternation of columns and line supports subjected to concentrated load, linearly distributed load and concentrated moment or combination of these loads. To check the accuracy of the method, three example problems have been computed and compared with the solution of Timoshenko (9), result of Yuthana (8) and finite element method.

In the first example, a simply supported square plate is selected to be analysed. In this example not only the accuracy of line supports is examined by comparing the results with solution of Timoshenko (9) but the characters of line support are also investigated by results of point support. The second example presents the advantage of short line supports in action as point supports. The results are compared with that of point supports in the former study by Yuthana (8). The last example is the typically plate problem with mixed of column and line supports. This example show the practical application of the method.

The boundary integral method create the system of simultaneous equations with the non-symmetric and fully populated influence matrix which requires a large incore memory to store all matrix coefficients. Computation has been performed on a mainframe computer IBM 3090/120E using double precision arithmatic but the program can run also on IBM PC with little modification on I/O unit specifier.

Example 1 : A simply supported square plate 8.0 x 8.0 m.x m. subjected to uniformly distributed load of 1,000 kg/m^2 is examined. Fig. 8 show the geometric and material properties. Loading area is divided into 64 strips. Boundary of plate and line support are divided into 16 and 3 intervals per side respectively. After first calculation, line supports are removed and point supports are placed at the nodal points of each element of line support and then the problem is recalculated. Fig.9 show the deflection along line of symmetry and the diagonal. Fig. 10 show the normal bending moment along line of symmetry and the diagonal.

It can be clearly seen from both figures that, using only 3 elements of line support, the results of this study closely agree with the solutions solved by Timoshenko (9). When replacing line supports with point supports not only the stress resultants but also the distribution of reaction are considerably different. Thus, in the case of lengthly continuous supported plate, the stress solutions obtained by using line supports would represent more accurate characteristic of the problem than using point supports with the same element number.

Example 2 : A square plate 8.0 x 8.0 m.x m. with four interior supports loaded by a concentrated force at it center is shown in Fig. 11. This problem has been calculated by Yuthana and resolved here again to show the advantage of short line support. All point supports are replaced with short line supports, 0.1 m. in length, which its alignment parallel to x-axis. Each side of plate boundary is divided into 10 intervals and line supports are not subdivided. The transverse deflection, normal bending moment and twisting moment depicted in Fig. 12 through Fig. 14.

It is evident from the figures that the stress resultants of this study show close agreement with those of point supports. this can be concluded that an element of short line support can be used to replace point support. According to Yuthana's study axes of point support should parallel to reference axes but axes of line support can be aligned in any direction. For this advantage of short line support, plate analysis by this approach is more convenient.

Example 3 : A typical flate plate structure subjected to uniformly distributed load of 1,500 kg/m^2 is supported by 12 columns and 2 line supports paralleled to y-axis. All the supports are rigid in axial deformation and free in rotational deformation except for tangential rotation of line support which is assigned to be rigid. Results of this example are compared with those of finite element program, SAP-IV. In SAP-IV program, a quadrilateral of arbitrary geometry formed from four compatible triangles is the element type used in modelling the plate element. Fig. 15 show the plate geometry and material properties together with the details of finite element

model prepared for the program SAP-IV. Each side of boundary and line support is subdivided into 14 and 6 intervals respectively and loading area is divided into 56 strips. Fig. 16 and Fig. 17 show the transverse deflection and normal bending moment respectively.

As seen from the figures, the results of this study are in good harmony with the results of finite element method. Comparing these stress resultants with those of SAP-IV, more internal forces are provided and easier in interpretation. For these reasons, boundary integral method should become an optional approach in analization the plate problem other than finite element method.

From the examples shown above, it can be concluded that the method presented has a flexibility to analyse wider scope of problems with satisfactory results. The equilbrium condition which has been examined by taking all support reactions and applied loads into account are also preserved. Unlike the finite element method, only the boundary of the problem is discretzed. Consequently, the data preparation effort is obviously reduced. However, there are some inconveniences or limitations in using the computer program such as

- when boundary of plate and line support are subdivided into too many intervals, inconsistencies of results may occur,
- subdivision of boundary and line supports has to be made in a suitable range to obtain the fairly results and to keep the computation effort within a reasonable limit,
- boundary, line supports and solution lines should not be coincident so that singularity due to r=0 may not be occured.

Furthermore, the method presented can be extended the capability to analyse others type of boundary conditions and make use of this for the symmetrical problems.